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are organisms, and second, if organisms, that the bulk of their substance is to be traced to nuclear secretions. The limits of the present reference will not permit an extensive analysis of Prowazek's different assumptions, but one or two matters may be pointed out as showing his method of treatment, and incidentally his ignorance or, possibly, disregard, of careful work of others. The organism of rabies, for example, exists, as do all rhizopod protozoa in many different sizes, and one form of the organism is extremely minute. This small phase is characteristic of the so-called "fixed virus" and has been entirely overlooked by Prowazek despite the accurate and detailed work of Dr. A. W. Williams and others. In another phase the organism is quite large and characteristically amœboid in form. Prowazek finds none of these larger forms in centrifuged virus and concludes that the intra-cellular phase is absent in the virus thus treated, and since he failed to see these forms in the fixed virus he further concludes that the bulk of the Negri body in rabies must be a nuclear secretion and that the organisms are the minute brightly staining points (chromatin) of the larger forms which are actually present in the fixed virus and in centrifuged virus, but invisible. In this conclusion he shows not only a total disregard for what other competent workers have done, but a surprising ignorance of the actual structure of the Negri body.

Apart from special criticisms which might be carried out for each of the diseases mentioned, the general criticism may be made that it is not good zoology to create a group in classification while there is still some doubt as to the organisms being living things; and it is not good cytology to assume an entirely new function (of specific secretions) in various cells in response to such questionable organisms. The present critic believes, indeed, that these questionable structures are organisms, and organisms belonging to the rhizopod group of protozoa, but not to any group with the characteristics of the proposed "Chlamydozoa."

G. N. C.

EXPERIMENTAL ZOOLOGY

The Determination of Sex in Frogs.—Few results in experimental biology have been more puzzling than those involving the question of the determination of the sex of the frog. The earliest observations—those of Born—seemed to indicate that the food given to the young tadpoles determined the sex of the frog. Yung also obtained about 70 per cent. of females when his tadpoles were well fed. Balbiani and Henneguy have stated that tadpoles fed on egg-yolk produced more females than those fed on a vegetarian diet. On the other hand, Cuénot obtained no such results, and the recent careful and extensive experiments of Miss King have shown clearly for the toad that the nutrition of the tadpole has no influence on the sex of the adult. Despite the fact that these recent results go far towards showing that sex is not determined or even altered by food relations, a curious disproportion of the sexes in frogs has been noted by several observers. The recent valuable experiments of Richard Hertwig do not, in the opinion of the reviewer, bear out the interpretation that Hertwig has placed upon them. Nevertheless, his methods give promise, if further extended, of throwing light on the problem.

In Hertwig's first contribution to the subject published in 1906 he suggested that sex is determined by the condition of *ripeness* of the egg at the moment of fertilization. This view is not new, and Hertwig's attempt to connect his view with the ratio of nucleus to cell-plasm of the egg at different periods of its maturation can hardly be looked upon favorably, since in the frog's egg the nucleus as such has already disappeared when the egg leaves the ovary. The chromosomes are thereafter arranged on the equatorial plate of the first polar spindle. It is, however, during this period that the degree of ripening is supposed to determine the sex of the egg. However unsatisfactory this specific suggestion of Hertwig may now appear, the possibility must still be granted that in some way the degree of maturity of the egg may have an influence on sex-determination. Hertwig interpreted his experiments to mean that at first the egg *tends* to produce males, then during the middle phases of its ripening it tends to produce females, and finally during its later phases again its tendency is towards male production. It is not our purpose to discuss in detail this interpretation, but it may be stated that Hertwig's experiments fell far short of proving his hypothesis.

In Hertwig's second paper,[1] to which we wish more especially to call attention, he also brings forward the same hypothesis and attempts to explain certain incongruities of the two series by other suggestions. It will be noticed that while the "older" eggs give an enormously high percentage of males, those first fertilized also give an excess of males or at least equal numbers of the two sexes. There is no middle register in which females are in excess.

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[1] Hertwig, R. Weitere Untersuchungen ueber das Sexualitätsproblem. *Verh. Deutsch. Zool. Gesell.*, 1907.

Hertwig's principal results are shown in the accompanying table. The eggs of three females, 1, 6, and 10, were fertilized at four different intervals (I, II, III, IV) of several hours apart (6, 18, 30, etc.); the percentages show in each case how many males developed to each 100 females—the actual number of individuals employed standing above the percentages. The striking fact shown by the table is the high percentage of males throughout, but especially towards the end of each series, where in one case there were 129 males to 17 females.

	I		II		III		IV
		— 6 —		— 18 —		— 30 —	
1.	34♀ : 47♂		65♀ : 77♂		156♀ : 194♂		7♀ : 48♂
	141%		119%		124%		685%
		— 36 —		— 18 —			
6.	64♀ : 61♂		101♀ : 139♂		115♀ : 169♂		
	95%		137%		147%		
		— 18 —		— 24 —		— 22 —	
10.	55♀ : 52♂		148♀ : 87♂		71♀ : 70♂		17♀ : 129♂
	100%		59%		100%		759%

The results leave little doubt that there is something in this series that stands for maleness. A number of possibilities besides the one adopted by Hertwig will suggest themselves. There is, moreover, one vital weakness in the experiment as carried out, for which, unfortunately, there is no control—different males were used, apparently, at least for the last fertilization, and the percentage of male-producing sperm present in these males was not determined. Without this control the experiment is seriously defective. Hertwig himself has realized this deficiency and has carried out one successful experiment in which the eggs of one female—separated into lots—were fertilized by different males. The results are not convincing, as the following statement shows.

The eggs of a female from a locality (Lochausen, indicated by L in the table), where the season was nearly at its end, were separated into six lots. Three of these were fertilized by sperm from three males of the same locality (indicated by l^1, l^2, l^3, in the table), and the other three were fertilized by sperm of three males from another locality (Schleissheim, $=$S in diagram). The converse experiment was also carried out. The results are given in the next table, in which the double sign ♀♂ indicates that the sexual organs were in an indifferent condition. It will be observed that a very large number of individuals are referred to this category. Hertwig states that in those cultures that developed best there was a decided excess of males—more than of indifferent forms. On the other hand, the poor cultures contained females almost exclusively, fewer indifferent forms and no males.

	l'	s'	l^2
L.	2♀♂ : 31♀	9♀♂ : 53♀	80♂ : 77♀♂
S.	9♀♂ : 65♀	†	77♂ : 73♀♂

	s^2	l^3
L.	176♂ : 156♀♂	———————
S.	10♂ : 75♀♂	9♂, 59♂♀ : 65♀♂, 11♀

Hertwig thinks that the results show that the sperm has a distinct influence on sex-determination. He suggests that in the present case the eggs were nearly in a condition of equilibrium so that a *slight* influence on the part of the male sufficed to turn the scales. He adds that it is thinkable that as a rule the eggs at the time of normal fertilization have their sex so positively determined that the relatively small influence of the male has no influence. It will be noted, however, that in Hertwig's own experiment the condition of the two females selected was very different, yet there is a surprising similarity in the results produced when the males that fertilized the eggs are considered.

The experimental results are not sufficient to give any positive light on the question, but the method that Hertwig has employed in the last experiment is one that promises to give an answer to the question whether the egg or the sperm determines the sex in the frog.

If one may hazard a guess, the results of Hertwig's experiments seem to show that the male is responsible for sex-determination. Since normally all the eggs are fertilized it can not be assumed that, if they are of two sexes, those of one sex are preponderatingly injured or killed by the cold of winter. In regard to the sperm, however, it is possible that more of one kind, if two kinds exist, are injured or that internal processes may lead to the production of more functional sperm of one sex. These factors may differ in different individuals or be characteristic of different races or regions. The importance of settling this question and the ease with which the experiment can be carried out with the simplest possible apparatus ought to lead many naturalists to repeat the experiment in different localities and with different species. The only difficulty arises from the mortality of the tadpoles; for they must be kept until the time of metamorphosis (which, however, for the wood frog, the toad and for some of the tree frogs takes place as early as June of the same year). By keeping the tadpoles in running water, or by changing the water in the dishes every day, success is assured.

M.

ANATOMY

Wiedersheim's Comparative Anatomy.[1] The various forms and editions of this work have been for two decades, we believe, the most used and useful text-books upon the comparative anatomy of vertebrates. In the ten years since the publication of the second English edition, three progressively larger German editions have appeared, and the book became so large that Wiedersheim published a résumé entitled "An Introduction to Comparative Anatomy." The third English edition is, in both size and substance, a compromise between the second English and the large German editions. The text proper occupies one hundred and ten pages more than in the second edition. This is due partly to the addition of new matter and partly to the use of uniform type in the text, instead of printing in smaller type the matter assumed to be less worthy of the student's attention. This change has improved the appearance of the book and the increase in size has been partly counterbalanced by printing more compactly and in smaller type the much extended and useful bibliography.

New facts have been incorporated, usually and unfortunately without recasting, but the sections upon the skin, skull, brain-

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[1] Comparative Anatomy of Vertebrates. Adapted from the German of Dr. R. Wiedersheim, by W. N. Parker. Third edition, founded on the sixth German edition. 576 pp., 372 figures. The Macmillan Company, 1907.